Protection Against Deicing Chemicals And Freeze-Thaw Environment

Our experience with concrete deterioration and reinforcing steel corrosion has shown that it is necessary to vary design details to suit the diverse climatic conditions and traffic volumes found in California. Design details which have produced adequate structures in mild climates have resulted in expensive maintenance problems on structures which are subjected to freeze-thaw cycles, deicing chemicals, and chain wear.

To define variations in specifications and details needed to suit conditions of traffic and exposure, the State is divided into three types of environmental areas. Attachment A is a map showing the approximate location of these areas which are defined as follows:

Area I

Mild climate, where frost is rare, or where, because of light traffic volumes, salt is applied infrequently. This area includes all portions of the State not specifically itemized as Areas II and III.

Area II

Moderate climate, where frost or light freezing occurs, but chains are seldom used. Salting of the deck is only done in rare or emergency instances. A list of State Highway routes showing post mile limits for this area is given in Attachment B.

Area III

Severe climate, where freeze-thaw cycles and heavy salting occur frequently and where chains are used. A list of State Highway routes showing post mile limits for this area is given in Attachment B.

Details and specifications for structures which are dependent on locations and traffic volume are shown in Table I. Interchange structures connecting two State Highways are to be treated as mainline structures. Special treatment will usually not be used on

Supersedes Memo to Designers 8-2 dated June 1989

overcrossings. In special cases where overcrossings are expected to be subjected to heavy applications of salt, or frosting or icing will occur, the need for details suitable to the area will be specified in the preliminary report.

Table I and the route tabulations in Attachment B are provided so that usual situations can be handled routinely. Deck protective systems may also be provided on other selected structures under certain conditions, or in other special cases the normal protective system may be eliminated. These special cases should be discussed with the Design Supervisor.

The state of the art for structure protection in adverse environment is such that new sealing materials or reinforcing steel protection materials showing promise will continue to come to our attention. To obtain operational history on new products our Applied Research Section will on occasion want to apply new seals, seal-overlay, concrete additives, etc., to selected structures in both Areas II and III.

Most of the requirements shown in Table I will be covered in the special provisions. However, the following items should be considered in preparing plans and estimating quantities:

1. Show proper concrete cover for deck slab.

2. For structures which are to be protected by the use of epoxy coated rebar, quantities of epoxy coated rebar should be shown separately. If a portion of a bar requires coating, for estimating quantity, assume the whole bar to be coated.

TABLE I

Item	Environmental Area I	II	III
Minimum Cement Factor (#/CY)			
Deck	658	658	658
Remainder of Bridge	564	564	658
Air Entrainment other than footings	No	No	6%[A]
Maximum Free Water-Decks (#/CY)	325	305	300
Specify Freeze-Thaw Aggregates	No	No	Yes
Minimum Cover over top layer of Deck Reinforcing and Approach Slab Reinforcing	2	2	2 1/2
Reinforcement Exposure Factor (Z) Refer BDS* 8.16.8.4	170	170	130
Prestress Allowable Tension (within the deck) Refer BDS* 9.15.2.2(b)	$6\sqrt{f'_c}$	$6\sqrt{f'_c}$	$3\sqrt{f'_c}$
Coefficient of Friction - deck surface	0.35	0.35	0.35
Seal Bents under deck expansion joints	No	No	Yes[B]
Epoxy Coated Reinforcement			
Decks (12" thick and less)	No	No	Yes
Decks (greater than12" thick) –			
Top mat only	No	No	Yes[C]
Curb and Barrier Rail	No	No	Yes
Approach Slabs	No	No	Yes

Footnotes:

[A] With 6% entrained air, concrete strengths higher than 4500 psi may be unobtainable with local aggregates. When concrete strength exceeding 4500 psi cannot be avoided, the Transportation Laboratory can recommend lower amounts of entrained air and water reducing agents that can be used with local aggregates to obtain the most durable concrete.

[B] Designers should avoid placing deck expansion joints where deck gutter runoff might drain onto the top of bents. Specify that the exposed portion of bents under expansion joints on structures carrying State Highway Traffic be sealed.

[C] Whether or not to epoxy coat the bottom steel in decks greater than 12" thick should be based on the expected frequency of salting and potential problems in performing restorations.

* *Bridge Design Specifications*

Floyd L. Mellen

Shannon H. Post

RFB:jh
Attachments